U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

PROJECTILE AND CARTRIDGES, SMOKE

1. OBJECTIVE

This MTP describes the methods, techniques and test requirements needed to determine the degree to which a smoke test projectile meets the requirements of its Qualitative Materiel Requirements (QMR), and Technical Requirements (TR), and its overall suitability for Army use.

2. BACKGROUND

Smoke projectiles are used as a screen against enemy observations, as an aid to an observer in locating rounds while adjusting fire, as a prearranged signal and as marking rounds for air observation or air strikes.

Presently, three types of smoke projectiles are used; (a) White phosphorous: a bursting projectile which produces smoke, incendiary effect and casualty effect; (b) HC Smoke: a base ejection type projectile that produces white smoke and is used primarily for screening purposes; (c) Colored Smoke Rounds (red, green, or yellow): a base ejection type projectile that is normally used for prearranged signals or as an aid to the forward observer in identifying his rounds.

For efficiency, effectiveness and safety during use, smoke projectiles meet the same standards that are required for high explosive and other types of artillery ammunition.

3. REQUIRED EQUIPMENT

a. Howitzer/Gun of appropriate caliber
b. Flash Central and Operating Personnel
c. Flash Observation Posts with Operating Personnel
d. Fire Direction Equipment and Operating Personnel
e. Motion Picture Camera and Color Film
f. Ammunition Transporters
g. Training Manuals appropriate to the test item
h. Standard Smoke Projectiles
i. Anemometer
j. Psychrometer
k. Powder Thermometer
1. Applicable Firing Range
m. Trained Forward and Aerial Observers

4. REFERENCES

A. AR 385-10, Army Safety Program.
B. AR 385-63, Firing Ammunition for Training, Target Practice and Combat.

C. AR 700-1300-B, Malfunctions Involving Ammunition and Explosives.
D. AMCR 385-12, Safety Verification of Army Materiel.
E. AMCR 385-24, Range Safety.
F. AMCR 385-224, AMC Safety Manual.
G. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing
H. TM 9-1300-203, Artillery Ammunition.
I. TM 9-1300-206, Care, Handling, Preservation and Destruction of Ammunition.
J. FM 6-40, Field Artillery Cannon Gunnery.
K. MTP 3-3-506, Accuracy and Precision.
L. MTP 4-3-500, Preoperational Inspection and Physical Characteristics.
M. MTP 4-3-502, Ammunition Functioning and Reliability.
N. MTP 4-3-504, User Reaction.
O. MTP 4-3-506, Adverse Conditions.
P. MTP 4-3-511, Transportability (Ammunition).
Q. MTP 4-3-513, Maintenance.
R. MTP 4-3-514, Safety Hazards.
S. MTP 4-3-515, Human Factors Engineering.
T. MTP 4-3-520, Field Storage.
U. MTP 4-3-521, Training Manuals and Technical Publications.

5. SCOPE

5.1 SUMMARY

This MTP describes the following tests:

a. Preparation for Test - A determination of the condition of the test item upon arrival, its physical characteristics, the availability of target ranges and operator training procedures.

b. Accuracy and Precision and Ballistic Match Test - A study to compare the ability of the test projectile to match a standard projectile in accuracy and precision.

c. Target Marking - A study to compare the ability of the test projectile to match a standard projectile in visibility in various terrains.

d. Building and Maintaining a Smoke Screen - A study to compare the smoke screen formed using standard projectiles with the smoke screen formed with test projectiles under various ambient conditions.

e. Adverse Conditions Test - A study to determine the effect of night, cold weather and rainy conditions in the preparation and use of the test items.

f. Field Storage Tests - A study to determine the effect of long-term storage, under various conditions, on the accuracy and reliability of the test items.

g. Transportability - An evaluation to determine the transportability of the test item.

h. Ammunition Functioning and Reliability - An evaluation to determine the functioning ability and reliability of the test item.

i. User Reaction - An evaluation to determine the reaction of test personnel to the firing of the test item.

j. Safety Hazards - A study to determine the test item's safety characteristics during performance.

k. Maintenance - An evaluation to determine the maintenance requirements of the test item.

l. Human Factors Engineering - An evaluation to determine the effectiveness of the test item weapon-crew relationship.

5.2 LIMITATIONS

The incendiary effect of white phosphorous projectiles shall not be covered in this MTP; it shall be covered during engineering testing. This MTP shall restrict itself strictly to the "smoke" ability of white phosphorous projectiles.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Personnel

a. Ensure the availability of service personnel who have been trained using the criteria of MTP 4-3-501 in conjunction with the appropriate technical publications and training manuals of MTP 4-3-521 and are competent in the handling, assembling, fuzing, maintaining, and firing of the test projectiles.

b. Record the following for all service personnel:

1) Rank
2) MOS
3) Experience in MOS
4) Training time in MOS

6.1.2 Preoperational Inspection and Physical Characteristics

Determine and record the physical characteristics and operational condition of the test items by subjecting them to the applicable procedures described in MTP 4-3-500.

6.1.3 Target Ranges

Select and schedule ranges that shall contain the following terrains and vegetation:

a. Open flat fields
b. Sparse woods on flat terrain
c. Dense woods on flat terrain
d. Open hilly fields
e. Sparse woods on hilly terrain
f. Dense woods on hilly terrain

6.1.4 Safety

The test officer will review the Safety Release to identify any safety limitations required during conduct of the test.

6.2 TEST CONDUCT

NOTE: Smoke projectiles are designed and used for special situations, and as such, use specially developed fired direction procedures that are detailed in reference 4K (FM 6-40).

6.2.1 Accuracy and Precision and Ballistic Match Testing

6.2.1.1 Preparation for Test

a. Assemble a sufficient number of test rounds, consisting of test projectiles and standard components, to meet the minimum requirements of the applicable section of MTP 3-3-506.

b. Assemble "standard rounds", using all standard components, equal in number to the test rounds of step a.

6.2.1.2 Test Conduct

Determine the accuracy and precision of the test rounds and their ballistic match with the standard rounds, using the procedures of the applicable section of MTP 3-3-506 and firing test rounds and standard rounds alternately and from the same weapon.

NOTE:
1. Ballistic match compatibility will have been achieved if the center of comparative groups are within the allowable range, deflection and height of burst probable errors of each other, as set forth in the test directive, and they have comparable dispersion patterns. Under these conditions, the test projectile is considered to "shoot" the same as the standard projectile and is, therefore, suitably accurate.
2. This accuracy and precision test will vary slightly from the normal procedure outlined in MTP 3-3-506. Time fuzes are used and the ten-round groups are fired with the same weapon settings and the same fuze settings at a point in the air. This will save ammunition in that the probable errors in range, deflection and height of bursts may be determined from each ten-round group.

6.2.2 Target Marking

a. Station trained observers and photographers (as available) at preset varying distances from expected burst points on an open field, and have aerial observers in position to view the smoke bursts.

b. Fire one round containing a red smoke test projectile and perform the following:

1) Have each ground observer indicate ease of identifying smoke and record the distance from the burst area and his opinion regarding the observed smoke.

2) Have each photographer photograph the smoke and record photographic distance to the burst area.
3) Have aerial observers indicate smoke visibility and record horizontal and veritcal distance to the burst area.

c. Repeat step b using a standard red projectile.
d. Repeat steps b and c using projectiles of all available colors.
e. Repeat steps a through d with the following type burst terrain:

1) Flat terrain with:

a) Sparse wood and shrubs
b) Dense woods

2) Hilly terrain with:

a) No vegetation
b) Sparse wood and shrubs
c) Dense woods

6.2.3 Building and Maintaining a Smoke Screen

a. Station trained observers, and photographers (as available), at preset varying distances from an open field.
b. Establish and maintain a smoke screen, using standard components, under the existing atmospheric conditions and perform the following:

1) Record the following:

a) Height and width of smoke screen
b) Ground level thickness of smoke screen
c) For each observer:

(1) Distance from smoke screen
(2) Apparent visibility through smoke screen
(3) Opinion regarding the observed smoke screen

d) Meteorological conditions while the screen is in existence:

(1) Ambient air temperature.
(2) Wind speed.
(3) Relative humidity.
(4) Intensity and direction of atmospheric turbulance, if applicable.

e) Effective time the screen remains after the final round has been fired.
f) Total number of rounds fired.
g) Total time expended between first and last round fired.

2) Obtain motion pictures of the smoke screen from first round fired to final dissipation by each photographer and identify distance from photographer to screen.

c. Repeat step b using test projectiles and standard components under the same meteorological conditions encountered in step b.

d. Repeat steps a through c under as many varying atmospheric conditions as possible encountered during the testing period (i.e., high humidity, maximum allowable wind speed; rising air, low humidity, minimum wind, no air turbulance).

6.2.4 Adverse Conditions

During the conduct of test, determine the effect of adverse conditions on the test items as described in the applicable sections of MTP 4-3-506.

6.2.5 Field Storage

Determine the effect of field storage upon the test item as described in the applicable sections of MTP 4-3-520.

6.2.6 Transportability

Determine the ability of the test item to withstand normal transport conditions without becoming defective as described in the applicable sections of MTP 4-3-511.

6.2.7 Ammunition Functioning

During the conduct of paragraph 6.2.1 through 6.2.6, determine the functioning and reliability of the test item as described in the applicable sections of MTP 4-3-502.

6.2.8 User Reaction

During the conduct of the test, observe and record "user reaction" as described in the applicable sections of MTP 4-3-504.

6.2.9 Safety

During the conduct of the test, determine and record any safety hazards as described in the applicable sections of MTP 4-3-514.

6.2.10 Maintenance

Determine the maintainability of the test item as described in the applicable section of MTP 4-3-513.

6.2.11 Human Factor Engineering

Determine the effectiveness of test item-weapon-crew relationship

during the conduct of the test as described in the applicable sections of MTP 4-3-515.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personnel

Record the following for all service personnel:

a. Rank
b. MOS
c. Experience in MOS, in years
d. Training time in MOS, in months

6.3.1.2 Preoperational Inspection and Physical Characteristics

Record data collected as described in the applicable sections of MTP 4-3-500.

6.3.2 Test Conduct

6.3.2.1 Accuracy and Precision and Ballistic Match Testing

Test and standard round data shall be recorded as collected in the applicable section of MTP 3-3-506.

6.3.2.2 Target Marking

Record the following for each round fired:

a. Color of smoke (red, yellow, etc.)
b. Type of projectile (test, standard)
c. Type of terrain (flat open, hilly dense wooded, etc.)
d. For each observer:

    1) Type (aerial or ground)
    2) Distance from burst area, in yards:

        a) Horizontal for ground and aerial
        b) Vertical for aerial

    3) Ease of identifying smoke
    4) Opinion regarding observed smoke

e. For all films:

    1) Location of photographer (ground, aerial)
    2) Distance from burst area, in yards:

a) Horizontal for ground and aerial
b) Vertical for aerial

6.3.2.3 Building and Maintaining a Smoke Screen

Record the following for each smoke screen:

a. Type of projectile (test, standard).
b. Height and width of smoke screen, in yards.
c. Ground level thickness of screen, in yards.
d. For each observer:

1) Distance from screen, in yards
2) Apparent visibility through screen
3) Opinion regarding observed smoke screen

e. Meteorological conditions:

1) Ambient air temperature, in °F
2) Wind speed, in mph
3) Relative humidity, in percent
4) For turbulance, if any:

a) Direction (up, down)
b) Intensity

f. Effective time screen remains, after firing last round, in minutes.
g. Total number of rounds fired.
h. Total time between first round fired and screen dissipation, in minutes.
i. For all films:

1) Distance from screen, in yards

6.3.2.4 Adverse Conditions

Record data as described in the applicable sections of MTP 4-3-506.

6.3.2.5 Field Storage

Record data as described in the applicable sections of MTP 4-3-520.

6.3.2.6 Transportability

Record data as described in the applicable sections of MTP 4-3-511.

6.3.2.7 Ammunition Functioning and Reliability

Record data as described in the applicable sections of MTP 4-3-502.

6.3.2.8 User Reaction

Record data collected as described in the applicable sections of MTP 4-3-504.

6.3.2.9 Safety Hazards

Record data as described in the applicable sections of MTP 4-3-514.

6.3.2.10 Maintenance

Record data as described in the applicable sections of MTP 4-3-513.

6.3.2.11 Human Factor Engineering

Record data as described in the applicable sections of MTP 4-3-515.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

All data shall be reduced and presented as described in the applicable sections of each appropriate MTP.

6.4.2 Accuracy and Precision and Ballistic Match Testing

a. Compare the accuracy and precision of the standard and test projectiles.

b. Chart centers of comparative groups (standard projectiles and test projectiles) and depict graphically the differences in probable errors (range, deflection and height of burst).

6.4.3 Target Marking

a. Analyze and present a narrative summary of observer's opinions and observations.

b. Use photographs to depict comparisons between standard and test projectiles.

c. Indicate required changes to applicable firing procedures in FM 6-40.

6.4.4 Building and Maintaining a Smoke Screen

a. Analyze and present a narrative summary of observer's opinions and observations.

b. Use photographs to depict comparisons between standard and test projectiles.

c. Indicate required changes to applicable firing procedures in FM 6-40.

6.4.5 Safety

A Safety Confirmation, based on the data of paragraph 6.3.2.9 shall be presented in accordance with USATECOM Regulation 385-6.